New Hampshire Volunteer River Assessment Program

2002

SUGAR RIVER

Water Quality Report

June 2003

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STATE OF NEW HAMPSHIRE

Volunteer River Assessment Program

2002

SUGAR RIVER

Water Quality Report

STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
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ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services (DES) -Volunteer River Assessment Program (VRAP) extends sincere thanks to the volunteers in the Sugar VRAP group during 2002. This report was created solely from data collected by volunteers listed below. A special acknowledgement is due to the students of the 2001 and 2002 Stevens High School Chemistry and Environmental Science classes. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

1.0 INTRODUCTION

1.1. Purpose of Report

Each year DES prepares and distributes a water quality report for each volunteer group that is based solely on the water quality data collected by the volunteer group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups. The purpose of this report is to present the data collected by the Sugar River volunteers in 2002.

1.2. Report Format

Each report includes the following:

- ✓ **Volunteers River Assessment Program (VRAP) Overview:** This section includes a discussion of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments. Also included is a summary showing the relative level of participation of all volunteers for the year expressed in terms of the number of sampling stations monitored. The chart enables the reader to compare the amount of participation among all volunteer groups supported by VRAP.

- ✓ **Water Quality Parameters Typically Selected for Monitoring**: This section includes a brief discussion of water quality parameters typically sampled by volunteers including why they are important to sample as well as applicable state water quality criteria or levels of concern.

- ✓ **Monitoring Program Description**: A description of the volunteer group's monitoring program is provided in this section including monitoring objectives as well as a table and map showing sample station locations.

- ✓ **Results and Discussion:** Water quality data collected during the year are summarized on a parameter-by-parameter basis using (1) a summary table that includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples of adequate assessment quality for each station, (2) a discussion of the data, (3) a list of applicable recommendations, and (4) a river graph showing the range of measured values at each station. Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows

New Hampshire surface water quality standards or levels of concern for comparison purposes.

- ✓ **Appendix – Data:** The appendix includes a spreadsheet showing the data results and additional information such as the time the sample was taken.

2. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

2.1. Past, Present, and Future

In 1998, the New Hampshire Department of Environmental Services (DES) initiated the New Hampshire Volunteer River Assessment Program (VRAP) as a means of expanding public education of water resources in New Hampshire. VRAP promotes education and awareness of the importance of maintaining water quality in rivers and streams. VRAP was created in the wake of the success of the existing New Hampshire Volunteer Lake Assessment Program (VLAP), which provides educational and stewardship opportunities pertaining to lakes and ponds to New Hampshire's residents.

Today, VRAP continues to serve the public by providing water quality monitoring equipment, technical support, and other educational programs. VRAP supports over a dozen volunteer groups on numerous rivers and watersheds throughout the state. These volunteer groups conduct water quality monitoring on an ongoing basis. The work of the VRAP volunteers increases the amount of river water quality information available to local, state and federal governments, which allows for effective financial resource allocation and watershed planning.

The intent of VRAP is to educate people of all ages and backgrounds about river and stream water quality, the threats to water quality posed by increasing population, development and industrialization, and the ways in which we can all work together to minimize these impacts.

2.2. Technical Support

VRAP lends and maintains water quality monitoring kits to volunteer groups throughout the state. The kits contain electronic meters and supplies for "in-the-field" measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters, such as nutrients, metals, and *E. coli,* can also be studied by volunteer groups, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages volunteer groups to pursue other fundraising activities such as association membership fees, special events, and in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

VRAP typically recommends sampling every other week during the summer, and citizen-monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results, meeting DES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

2.3. Training and Guidance

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. During the training, volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteer organizations forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

2.4. Data Usage

2.4.1. Public Outreach/Water Quality Reports

All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each individual volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

2.4.2. State Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic DES surface water quality assessments. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the DES web page to review the assessment methodology and list of impaired waters http://www.des.state.nh.us/wmb/swqa/.

2.5. Volunteer Participation in 2002

Figure 2-1 shows the level of volunteer participation in 2002 expressed in terms of the number of sampling stations monitored by each VRAP group. The chart provides an idea of the overall contribution by VRAP participants to statewide monitoring efforts and also allows monitoring groups to see how they compare to one another.

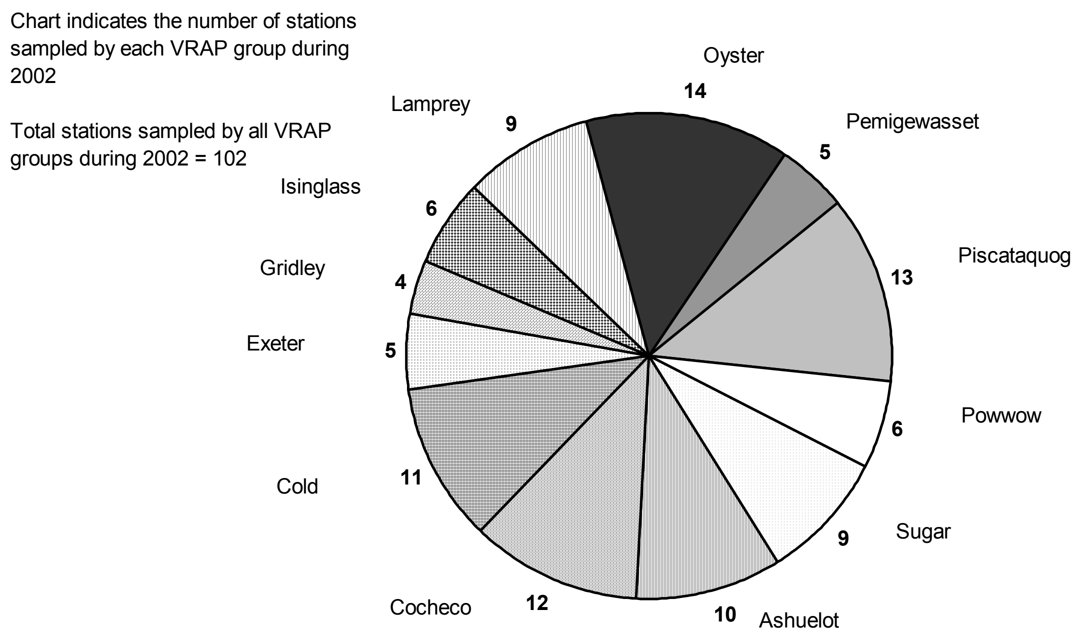


Figure 2-1. Volunteer water quality monitoring participation under DES VRAP during 2002.

3. WATER QUALITY PARAMETERS TYPICALLY MEASURED BY VRAP VOLUNTEERS

3.1. Temperature

Temperature is one of the most important and commonly observed water quality parameters. Temperature influences the rate of many physical, chemical and biological processes in the aquatic environment. Each aquatic species has a range of temperature and other factors that best support its reproduction and the survival of offspring. Temperature can also impact aquatic life because of its influence on parameters such as ammonia as well as the concentration of dissolved oxygen in the water.

Temperature in Class B waters shall be in accordance with RSA 485-A:8, II which states in part "any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class."

3.2. Dissolved Oxygen

Adequate oxygen dissolved in the water is crucial to the survival and successful reproduction of many aquatic species. Organisms such as fish use gills to transfer oxygen to their blood for vital processes that keep the fish active and healthy. Oxygen is dissolved into the water from the atmosphere, aided by wind and wave action where it tumbles over rocks and uneven stream beds. Aquatic plants and algae produce oxygen in the water, but this contribution is offset by respiration at night as well as by bacteria which utilize oxygen to decompose plants and other organic matter into smaller and smaller particles.

Oxygen concentrations in water are measured using a meter that produces readings for both milligrams per liter (mg/L) and percent (%) saturation of dissolved oxygen (DO). For Class B waters, any single DO reading must be greater than 5 mg/L for the water to meet New Hampshire water quality standards. This means that in every liter of water there must be at least five milligrams of dissolved oxygen available for ecosystem processes.

More than one measurement of oxygen saturation taken in a twenty-four hour period can be averaged to compare to the standards. Class B waters must have a dissolved oxygen content of not less than 75% of saturation, based on a daily average. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the percent saturation has recovered to acceptable levels. Water can become saturated with more than 100% dissolved oxygen. It should be noted that other DO requirements in the New Hampshire Surface Water Quality Regulations (Env-Ws 1700) pertain to cold water fish spawning areas, impoundments (dams), and reservoirs.

3.3. pH

pH is a measure of hydrogen ion activity in water. The lower the pH, the more acidic the solution due to higher concentrations of hydrogen ions. A high pH is indicative of an alkaline or basic environment. pH is measured on a logarithmic scale of 0 to 14. NH rivers typically fall within the range of pH values from 6 to 8. Most aquatic species need a pH of between 5 and 9. pH also affects the toxicity of other aquatic compounds such as ammonia and certain metals.

New Hampshire Surface Water Quality Regulations (Env-Ws 1700) state that pH shall be between 6.5 and 8, unless naturally occurring. Readings that fall outside this range may be due to natural conditions such as the influence of wetlands near the sample station or because of the soils and bedrock in the area. Tannic and humic acids released to the water by decaying plants, for example, can create more acidic waters in areas influenced by wetlands. Low pH can also be due to atmospheric deposition of chemicals emitted by sources such as fossil fuel power plants and car emissions. When it rains, the chemicals in the atmosphere can lower the pH of the rain (commonly referred to as "acid rain"), which can, in turn, lower the pH of the river or stream. Acid rain typically has a pH of 3.5 to 5.5.

3.4. Specific Conductance

Specific conductance (informally termed conductivity) is the numerical expression of the ability of water to carry an electric current, and is a measure of the free ion content in the water. Water contains ions (charged particles) which can come from natural sources such as bedrock, or be introduced by human activity. The free ions carry an electrical current. Conductivity can be used to indicate the presence of chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, iron, and aluminum ions.

There is no numeric standard for conductivity because levels naturally vary a great deal according to the geology of an area. Conductivity readings are useful for screening an area to determine potential pollution sources.

3.5. Turbidity

Turbidity is an indicator of the amount of suspended material in the water, such as clay, silt, algae, suspended sediment, and decaying plant material. A high degree of turbidity can scatter the passage of light through the water, and inhibit light from reaching important areas. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events often contribute turbidity to surface waters by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. According to New Hampshire's Surface Water Quality Regulations (Env-Ws 1700), Class B waters shall not exceed naturally occurring conditions by more than 10 Nephelometric Turbidity Units (NTU).

3.6. Bacteria

Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals. *Escherichia coli* (*E. coli*) bacteria is not considered pathogenic. *E. coli* is, however, almost universally found in the intestinal tracts of humans and warm blooded animals and is relatively easy and inexpensive to measure. For these reasons *E. coli* is used as an indicator of fecal pollution and the possible presence of pathogenic organisms.

In fresh water, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming. According New Hampshire's surface water quality standards, Class B waters shall contain not more than either a geometric mean based on at least three samples obtained over a sixty-day period of 126 *E. coli* per one hundred milliliters (CTS/100mL), or greater than 406 *E. coli* CTS/100mL in any one sample.

3.7. Total Phosphorus

Phosphorus is a nutrient that is essential to plants and animals, however, in excess amounts it can cause rapid increases in the biological activity in water. This may disrupt the ecological integrity of streams and rivers.

Phosphate is the form of phosphorus that is readily available for use by aquatic plants. Phosphate is usually the limiting nutrient in freshwater streams, which means relatively small amounts of phosphate can have a large impact the biological activity in the water. Excess phosphorus can trigger nuisance algal blooms and aquatic plant growth, which can decrease oxygen levels and the attractiveness of waters for recreational purposes.

Phosphorus can be an indicator of sewage, animal manure, fertilizer, erosion, and other types of contamination. There is no surface water quality standard for phosphorus due to the high degree of natural variability and the difficulty of pinpointing the exact source. However 0.05 mg/L total phosphorus is typically used as a level of concern, which means DES pays particular attention to readings above this level.

3.8. Metals

Depending on the metal concentration, its form (dissolved or particulate) and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on the pH of the water, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic. Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. Numeric criteria for metals may be found in New Hampshire's Surface Water Quality Regulations (Env-Ws 1700).

4. MONITORING PROGRAM DESCRIPTION

During 2000 a volunteer water quality sampling program was begun on the Sugar River. This effort provides water quality data relative to surface water quality standards. An ongoing effort will allow for an understanding of the river's dynamics, or variations, on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, and technical assistance to the volunteers.

The Sugar River VRAP group has tested for not only the core VRAP water quality monitoring parameters but also bacteria, arsenic, nitrogen, total phosphorous, mercury, lead, biological oxygen demand, and alkalinity. The sampling program implemented by the Sugar River volunteers has been one of the most comprehensive since VRAP was begun.

In addition to the volunteer effort, the U.S. Environmental Protection Agency (EPA) and DES initiated a water quality sampling program to support the development of a total maximum daily load (TMDL) for the Sugar River. This work focused on dissolved oxygen. Sampling stations were established in Sunapee and continued to Claremont. As noted throughout this document, DES recommends continued monitoring for dissolved oxygen and pH. Regarding dissolved oxygen, continued monitoring will benefit the public and DES by providing data before and after implementation of the TMDL. The data collected by the Sugar River volunteers will be invaluable in supplementing the ongoing TMDL.

During 2002, seven sites along the mainstem of the Sugar River and one on both the North and South branches were monitored by volunteers. Sampling stations descriptions are provided in Table 4-1 and locations are shown on the foldout map on the following page.

Table 4-1. Sampling station geographic information for the Sugar River, VRAP, 2002.

Station ID	Location	Town/City	Elevation*
19-Sgr	Route 11 Bridge	Sunapee	1100
16-Sgr	Route 103 Bridge	Sunapee	1000
12-Sgr	Route 10 Bridge	Newport	800
10-Sgr	Oak Street Bridge	Newport	800
7-Sgr	Kellyville Bridge	Newport	700
5-Sgr	Puksta Bridge	Claremont	600
1-Sgr	Lottery Bridge	Claremont	300
4-Ssr	Lear Hill Road	Goshen	1000
2-Nsr	Route 10 Bridge	Croydon	800

*Elevations have been rounded off to 100-foot increments for purposes of calibrating the dissolved oxygen meter.

5. RESULTS AND DISCUSSION

5.1. Dissolved Oxygen

5.1.1. Results and Discussion

Twelve or thirteen measurements were taken in the field for dissolved oxygen (DO) concentration at nine stations in five different towns along the Sugar River (Table 5-1). Twenty-one measurements met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency (EPA). On numerous occasion there was no dissolved oxygen calibration value listed on the data sheets thus DES is unable to use these data points in our reporting to EPA.

The Class B New Hampshire surface water quality standard for DO includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting DO standards.

Table 5-1. Dissolved oxygen data summary for the Sugar River, New Hampshire, March to December, 2002, DES VRAP.

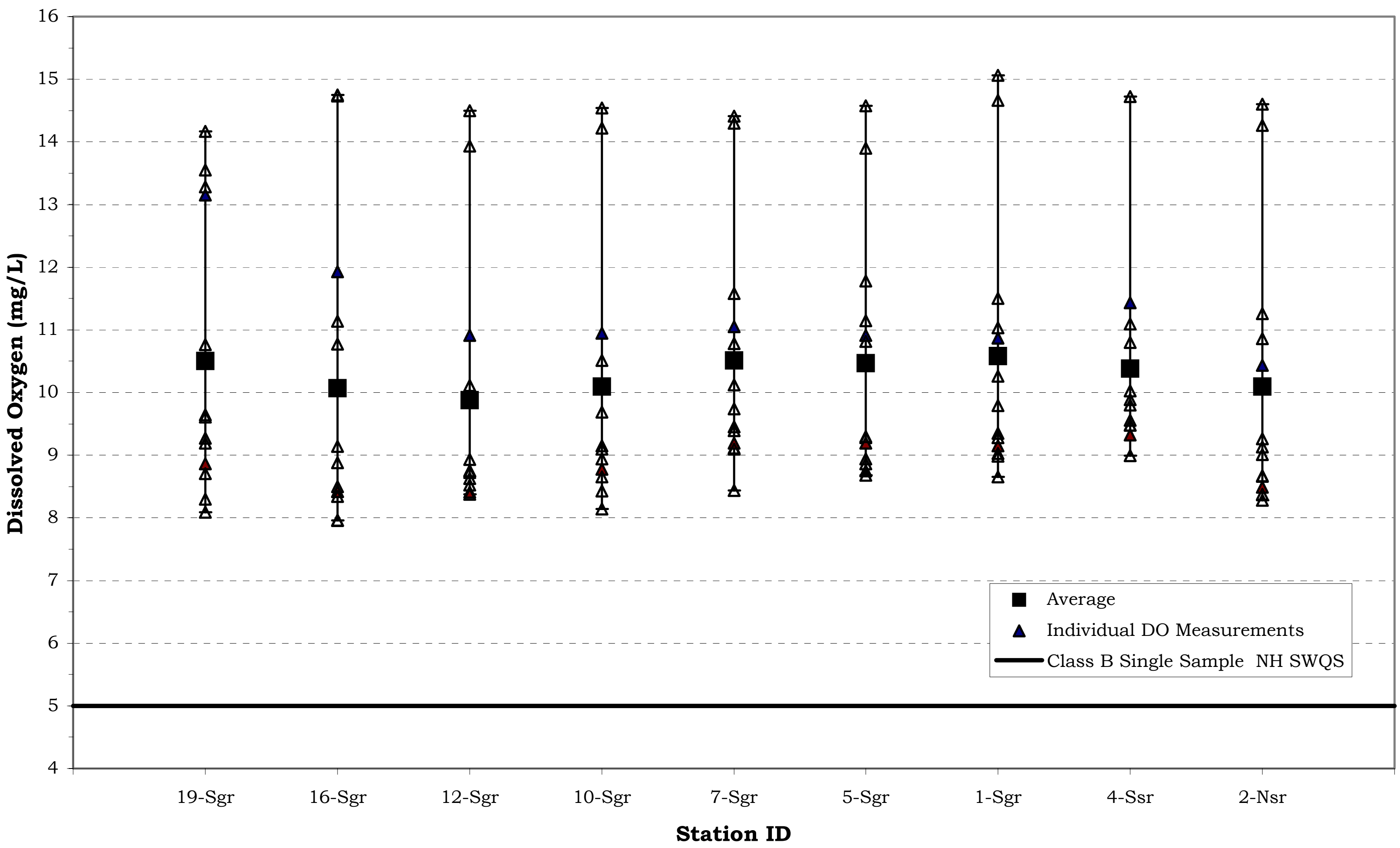
Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	13	8.09 - 14.17	0	8
16-Sgr	13	7.96 - 14.75	0	0
12-Sgr	13	8.38 - 14.5	0	2
10-Sgr	13	8.14 - 14.54	0	2
7-Sgr	13	8.44 - 14.41	0	2
5-Sgr	13	8.68-14.6	0	1
1-Sgr	13	8.65 - 15.06	0	2
4-Ssr	12	8.99 - 14.72	0	3
2-Nsr	13	8.28 - 14.6	0	1
Total measurements/samples by Sugar group				116

On all occasions at all stations dissolved oxygen levels were above New Hampshire surface water quality standards [Figure 5-1]. Levels of dissolved oxygen sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions.

5.1.2. Recommendations

- Continue sampling at all stations to develop a long-term data set to better understand trends as time goes on.
- If possible, take measurements between 6:00 a.m. and 8:00 a.m., which is when DO is usually the lowest, and between 12:00 noon and 3:00 p.m. when DO is usually the highest. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

Figure 5-1 Dissolved Oxygen Statistics for the Sugar River, New Hampshire, March 5 - December 10, 2002, NHDES VRAP



5.2. pH

5.2.1. Results and Discussion

Twelve or thirteen measurements were taken in the field for pH at nine stations in five different towns along the Sugar River (Table 5-2). Seventeen measurements met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. On numerous occasion there was no pH calibration slope value listed on the data sheets thus DES is unable to use these data points in our reporting to EPA. The Class B New Hampshire surface water quality standard is 6.5-8.0, unless naturally occurring.

Table 5-2. pH data summary for the Sugar River, New Hampshire, May to December, 2002, DES VRAP.

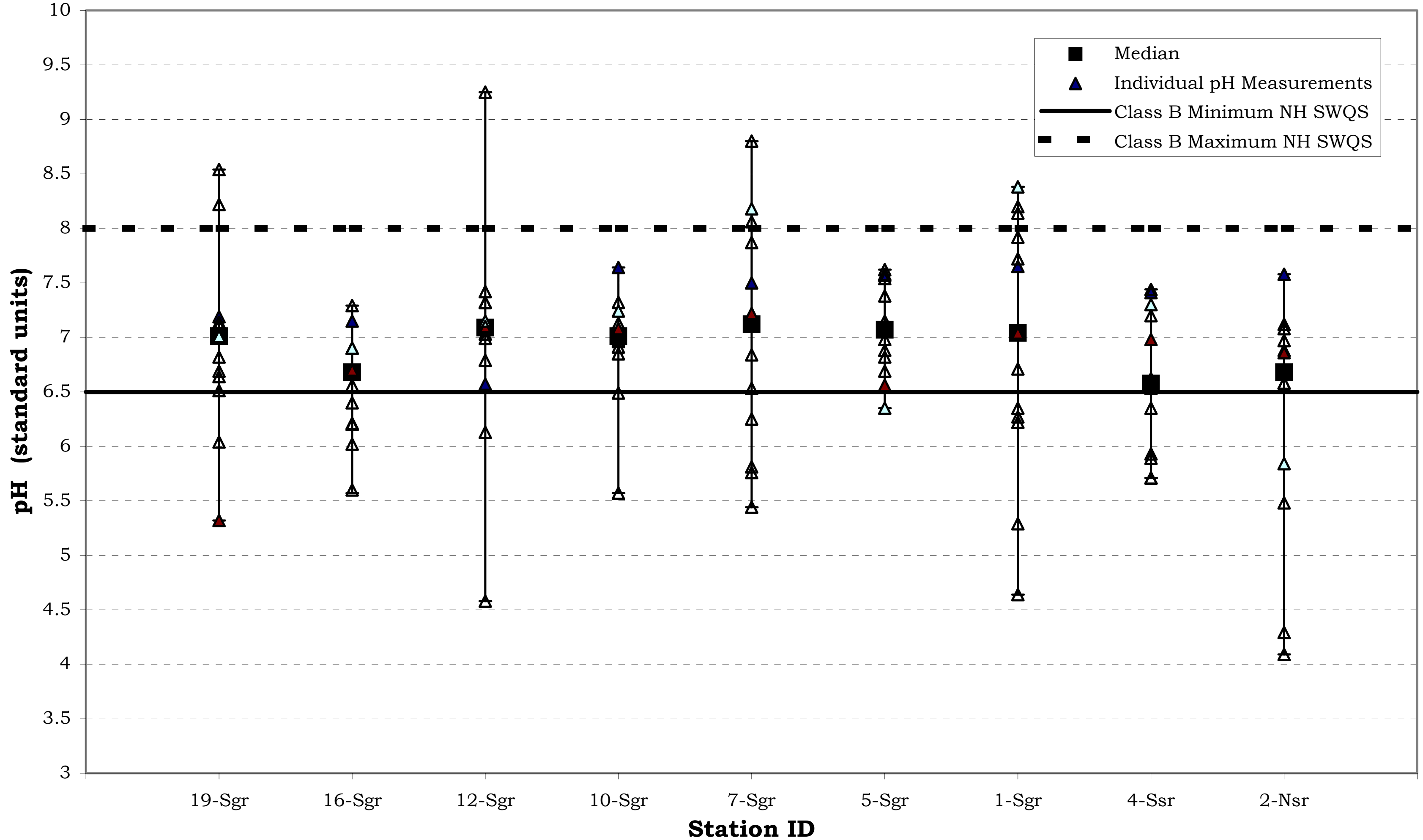
Station ID	Samples Collected	Data Range (Std. units)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	13	5.32 - 8.54	4	8
16-Sgr	13	5.57 - 7.29	5	1
12-Sgr	13	4.58 - 9.25	3	1
10-Sgr	13	5.57 - 7.64	1	1
7-Sgr	13	5.54 - 8.8	7	1
5-Sgr	13	6.35-7.62	1	2
1-Sgr	13	4.64 - 8.38	8	2
4-Ssr	12	5.71 - 7.44	5	1
2-Nsr	13	4.09 - 7.58	4	0
Total measurements/samples by Sugar group				116

Many of the pH measurements were below the range of the New Hampshire surface water quality standard (Figure 5-2). This is likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels.

5.2.2. Recommendations

- Continue sampling at all stations to develop a long-term data set to better understand trends as time goes on.
- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

Figure 5-2 pH Statistics for the Sugar River, New Hampshire, March 5, - December 10, 2002, NHDES VRAP



5.3. Turbidity

5.3.1. Results and Discussion

Twelve or thirteen measurements were taken in the field for turbidity at nine stations in five different towns along the Sugar River (Table 5-3). All measurements met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

Table 5-3. Turbidity data summary for the Sugar River, New Hampshire, May-December, 2002, DES VRAP.

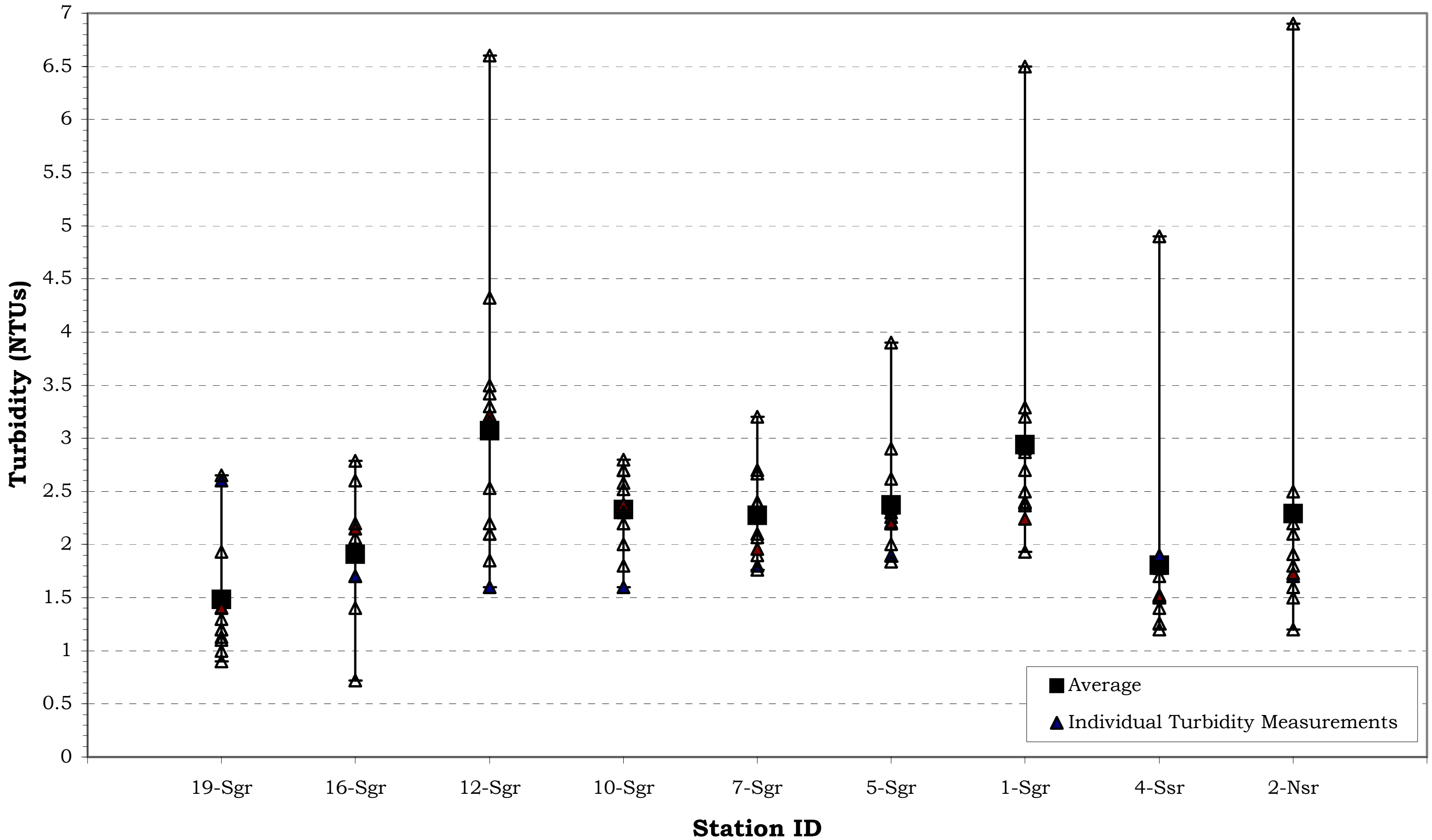
Station ID	Samples Collected	Data Range (NTUs)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	12	0.9 - 2.65	0	12
16-Sgr	13	0.72 - 2.79	0	13
12-Sgr	13	1.6 - 6.6	0	13
10-Sgr	13	1.6 - 2.8	0	13
7-Sgr	13	1.76 - 3.2	0	13
5-Sgr	13	1.84-2.62	0	13
1-Sgr	12	1.93 - 6.5	0	12
4-Ssr	12	1.2 - 4.9	0	12
2-Nsr	12	1.2 - 6.9	0	12
Total measurements/samples by Sugar group				113

Turbidity levels were low throughout the entire reach of river (Figure 5-3). In general it is typical to see a rise in turbidity in more developed areas due to increased runoff. Turbidity levels during 2002 will be a useful indicator of the typical background conditions of the river.

5.3.2. Recommendations

- Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- If possible sample for turbidity during or just after wet weather; this will help us to understand how the river responds to runoff and sedimentation.

Figure 5-3 Turbidity Statistics for the Sugar River, New Hampshire, March 5, - December 10, 2002, NHDES VRAP



5.4. Specific Conductance

5.4.1. Results and Discussion

Twelve or thirteen measurements were taken in the field for specific conductance at nine stations in five different towns along the Sugar River (Table 5-4). All measurements met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. A Class B New Hampshire surface water quality standard does not exist for specific conductance.

Table 5-4. Specific conductance data summary for the Sugar River, New Hampshire, May-December, 2002, DES VRAP.

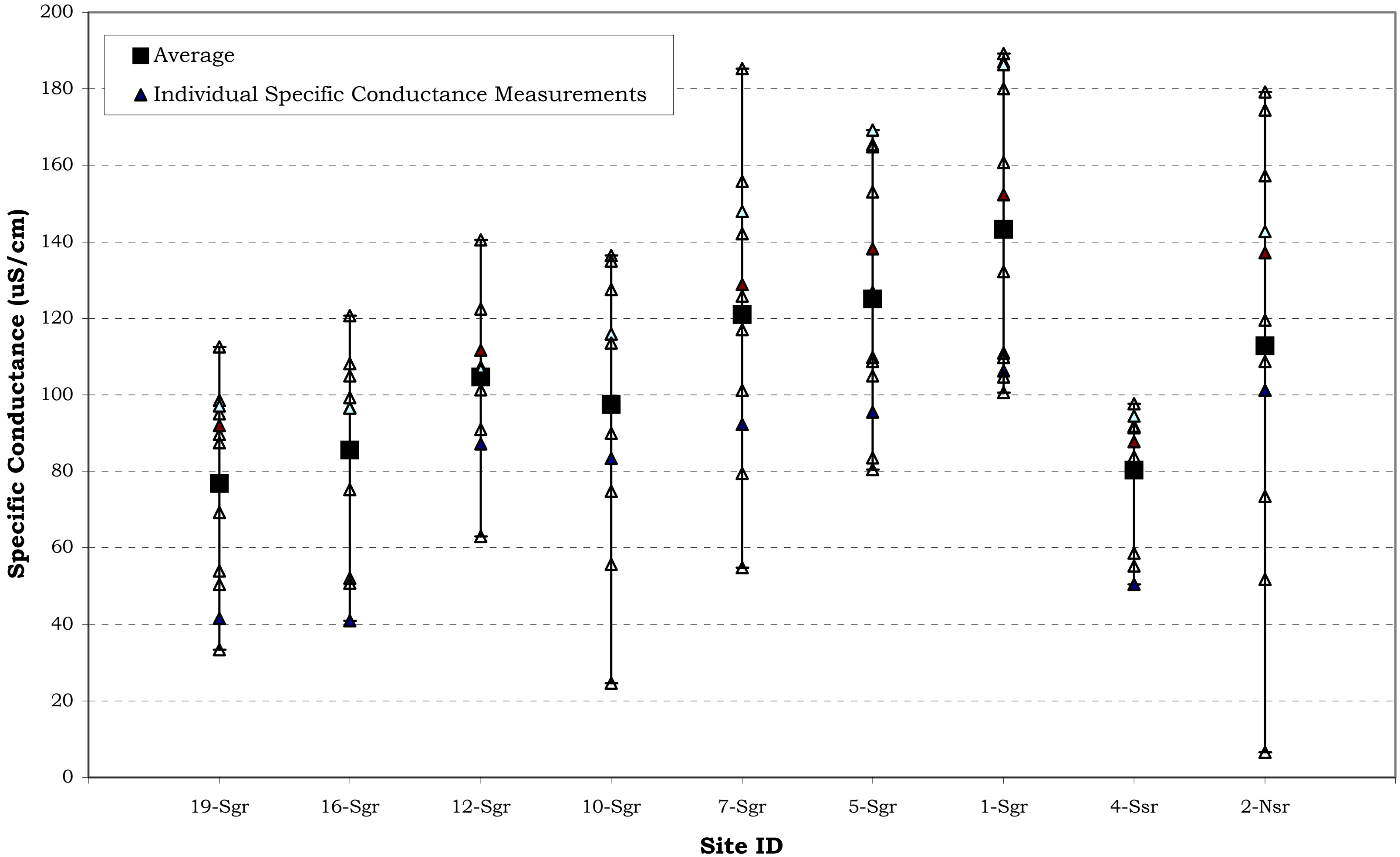
Station ID	Samples Collected	Data Range (NTU)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	12	33.4 - 112.5	Not Applicable	12
16-Sgr	11	40.9 - 120.7	N/A	11
12-Sgr	11	63 - 140.5	N/A	11
10-Sgr	12	24.7 - 136.4	N/A	12
7-Sgr	11	54.8 - 185.3	N/A	11
5-Sgr	12	80.5-169.3	N/A	12
1-Sgr	12	100.6 - 189.2	N/A	12
4-Ssr	10	50.4 - 97.7	N/A	10
2-Nsr	12	6.5 - 179.1	N/A	12
Total measurements/samples by Sugar group				103

Specific conductance levels were variable along the entire reach of the river [Figure 5-4]. In general, stations in more developed area tend to have higher specific conductance measurements due to increased runoff Anions (negatively charged elements such as chloride) and cations (positively charged elements such as calcium) are typically found in rivers flowing through developed areas. Specific conductance tends to increase in throughout the summer, because elevated river flows during the spring dilute specific conductance levels.

5.4.2. Recommendations

- Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.

Figure 5-4 Specific Conductance Statistics for the Sugar River, New Hampshire, March 5, - December 10, 2002, NHDES VRAP



5.5. E. coli

5.5.1. Results and Discussion

Eleven or twelve measurements were taken in the field for *E.coli* at nine stations in five different towns along the Sugar River (Table 5-5). All measurements met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for *E.coli* are as follows:

<406 cts/100 ml, based on any single sample, or
<126 cts/100 ml, based on a geometric mean calculated from 3 samples collected within a 60-day period.

Table 5-5. *E. coli* data summary for the Sugar River, New Hampshire, May-December, 2002, DES VRAP.

Station ID	Samples Collected	Data Range (CTS/100ml)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	11	0 - 20	0	11
16-Sgr	12	0 - 119	0	12
12-Sgr	12	2 - 306	0	12
10-Sgr	12	2 - 308	0	12
7-Sgr	11	8 - 89	0	11
5-Sgr	11	0-110	0	11
1-Sgr	12	5 - 455	1	12
4-Ssr	11	4 - 396	0	11
2-Nsr	11	0 - 80	0	11
Total measurements/samples by Sugar group				103

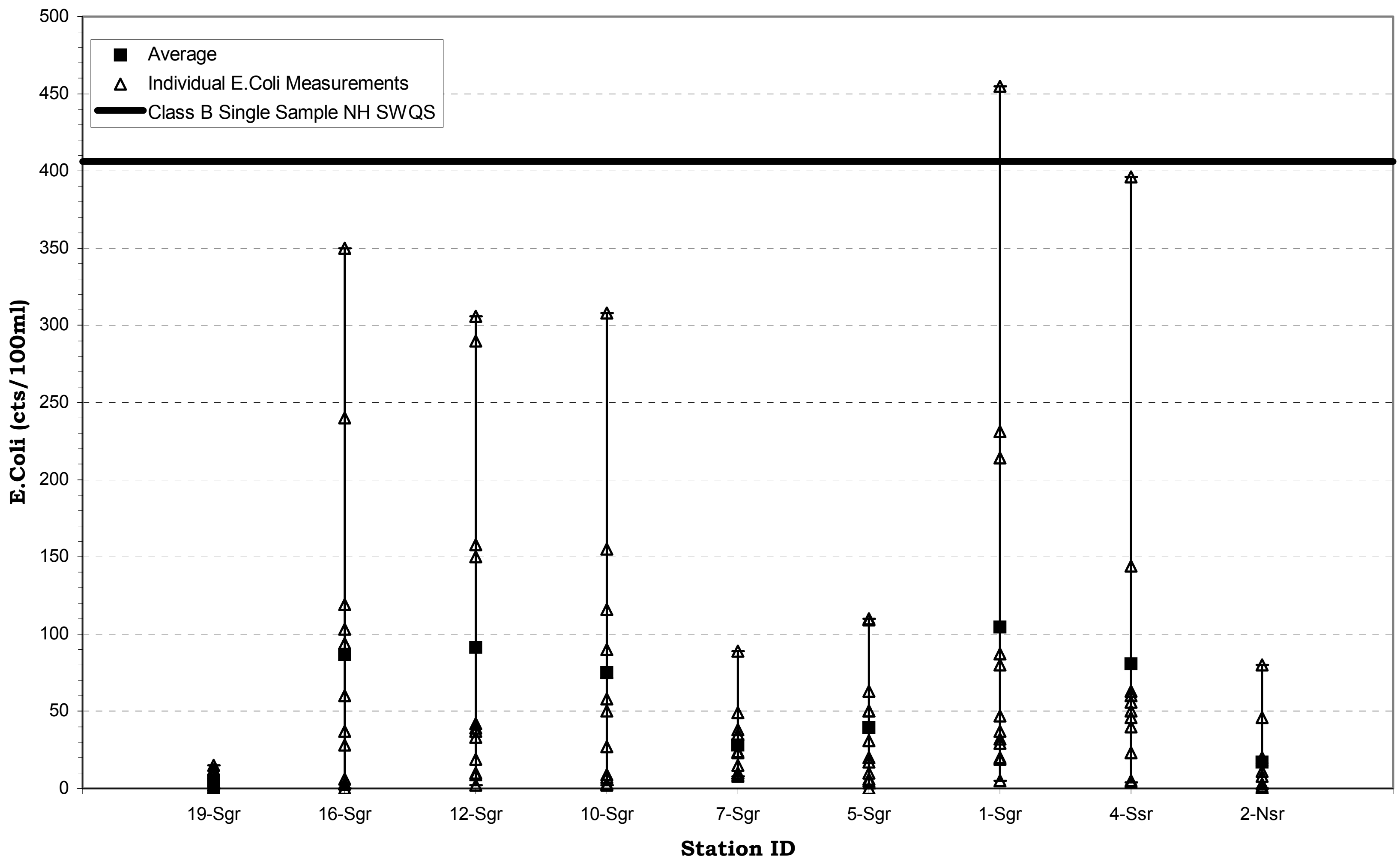
E. coli levels were variable along the entire reach of the river, but only on one occasion did they exceed the New Hampshire surface water quality standard (Figure 5-5).

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), and the presence of septic systems along the river.

5.5.2. Recommendations

- For each station monitored for *E.coli* collect three samples within any 60-day period during the summer.
- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).

Figure 5-5 *E.coli* Statistics for the Sugar River, New Hampshire, March 5, - December 10, 2002, NHDES VRAP



5.6. Nitrate/Nitrite

5.6.1. Results and Discussion

Between five and nine samples were collected for nitrate/nitrite at nine stations in five different towns along the Sugar River (Table 5-6). All sample results met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. A numeric Class B NH surface water quality standard does not exist for nitrate/nitrite.

Table 5-6. Nitrate/Nitrite data summary for the Sugar River, New Hampshire, May-December, 2002, DES VRAP.

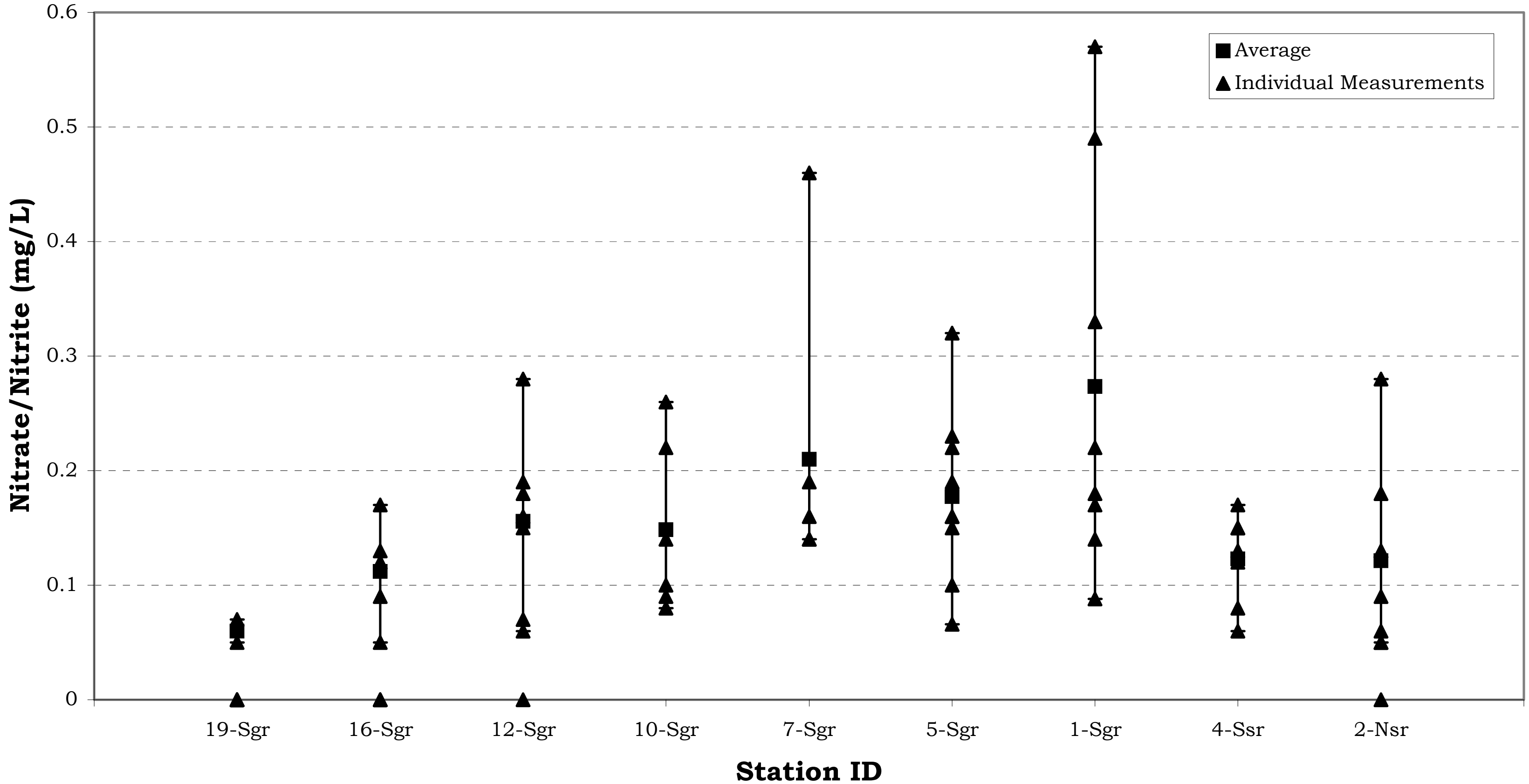
Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	7	<0.05 - 0.07	Not Applicable	7
16-Sgr	8	<0.05 - 0.17	N/A	8
12-Sgr	8	<0.05 - 0.28	N/A	8
10-Sgr	6	0.08 - 0.26	N/A	6
7-Sgr	6	0.14 - 0.46	N/A	6
5-Sgr	5	0.066-0.32	N/A	5
1-Sgr	8	0.088 - 0.57	N/A	8
4-Ssr	7	0.06 - 0.17	N/A	7
2-Nsr	9	<0.05 - 0.28	N/A	9
Total measurements/samples by Sugar group				64

Nitrogen levels varied along the river with measurements ranging from undetectable levels to as high as 0.46mg/L in Newport [Figure 5-6]. Nitrogen is naturally occurring in soil in organic forms from decomposing plant and animal matter. Nitrification is a microbial process by which nitrogen compounds (primarily ammonia) are oxidized to create nitrate and nitrite, nitrogen-oxygen chemical units. Primary sources which can cause increased nitrate levels are human sewage, livestock manure, and agricultural fertilizers. Elevated nitrate levels can be attributed to land and water management practices.

5.6.2. Recommendations

- Continue sampling at all stations; this will help to build a long-term data set to better understand trends as time goes on.

Figure 5-6 Nitrate/Nitrite Statistics for the Sugar River, New Hampshire, March 5, - December 10, 2002, NHDES VRAP



5.7. Total Phosphorus

5.7.1. Results and Discussion

Between four and eight samples were collected for total phosphorous at 9 stations in five different towns along the Sugar River (Table 5-10). All sample results met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. A numeric Class B NH surface water quality standard does not exist for total phosphorus.

Table 5-7. Total Phosphorus data summary for the Sugar River, New Hampshire, May-December, 2002, DES VRAP.

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	6	<0.005 - 0.015	Not Applicable	6
16-Sgr	6	0.012 - 0.84	N/A	6
12-Sgr	4	0.042 - 0.112	N/A	4
10-Sgr	4	0.029 - 0.063	N/A	4
7-Sgr	6	0.021 - 0.087	N/A	6
5-Sgr	5	0.03-0.41	N/A	5
1-Sgr	7	0.016 - 0.077	N/A	7
4-Ssr	7	0.01 - 0.016	N/A	7
2-Nsr	8	0.007 - 0.02	N/A	8
Total measurements/samples by Sugar group				53

A total phosphorus concentration of 0.05 mg/L is used by DES as a level of concern and DES pays particular attention to results above this level. A few of the total phosphorous concentration measurements did exceed this DES level of concern [Figure 5-7).

The primary source of excessive phosphorous concentrations in aquatic ecosystems comes from wastewater treatment facilities. Sewage, which typically has a heavy load of phosphate detergents contributes the majority of all phosphorous reaching lakes and rivers.

5.7.2 Recommendations

- Continue sampling at all stations; this will help to build a long-term data set to better understand trends as time goes on.

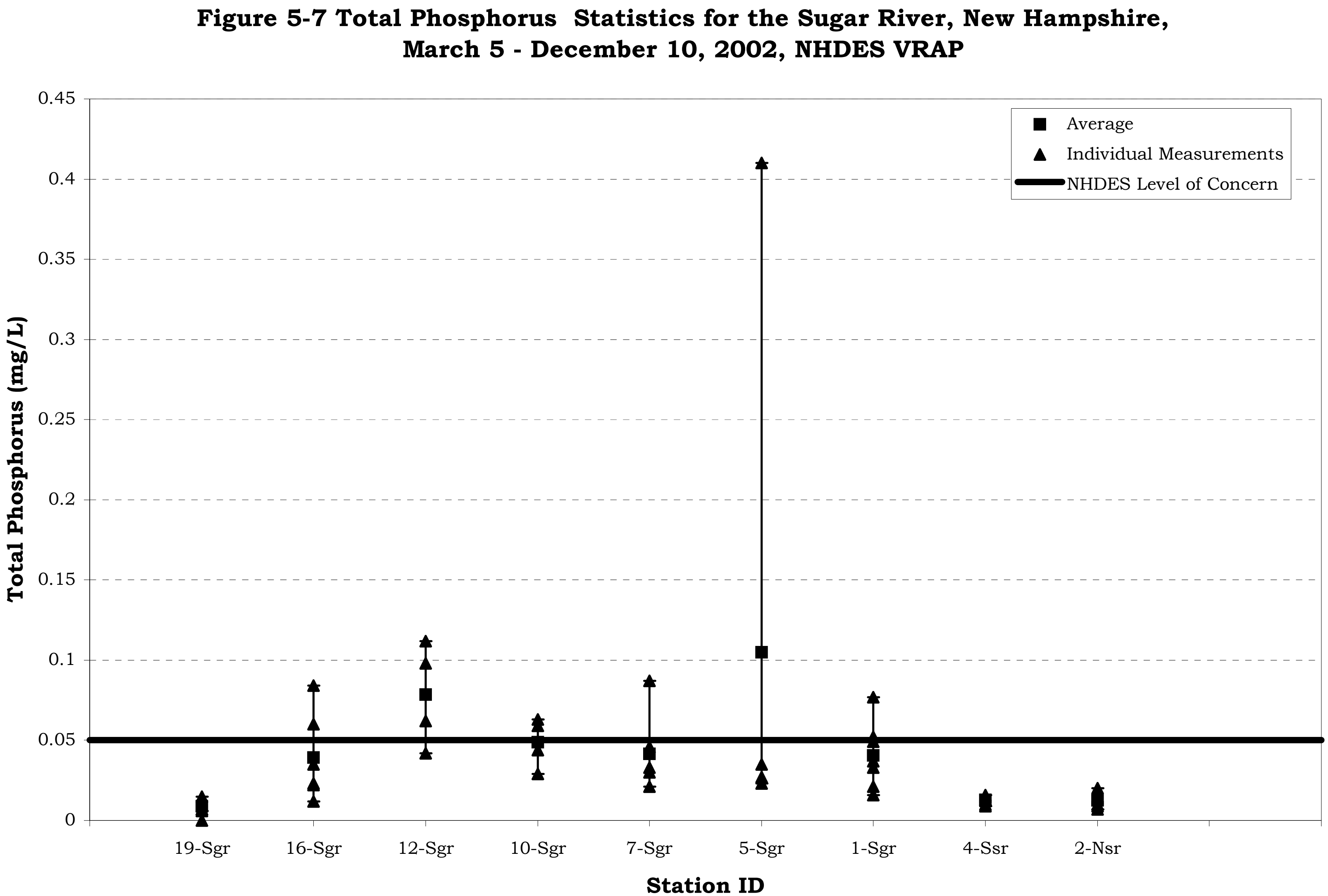


Figure 5-7 Total Phosphorus Statistics for the Sugar River, New Hampshire,
March 5 - December 10, 2002, NHDES VRAP
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Total Phosphorus (mg/L)
Average
Individual Measurements
NHDES Level of Concern
19-Sgr
16-Sgr
12-Sgr
10-Sgr
7-Sgr
5-Sgr
1-Sgr
4-Ssr
2-Nsr
Station ID

5.8. Mercury

5.8.1. Results and Discussion

Between four and eight samples were collected for mercury at nine stations in five different towns along the Sugar River (Table 5-8). All sample results are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for mercury are as follows:

freshwater chronic criterion <0.00077 mg/l
freshwater acute criterion <0.0014 mg/l

Table 5-8. Mercury data summary for the Sugar River, New Hampshire, May-December , 2002, DES VRAP.

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	4	<0.001	0	4
16-Sgr	4	<0.001	0	4
12-Sgr	5	<0.001	0	5
10-Sgr	4	<0.001	0	4
7-Sgr	8	<0.001	0	8
5-Sgr	7	<0.001	0	7
1-Sgr	7	<0.001	0	7
4-Ssr	6	<0.001	0	6
2-Nsr	7	<0.001	0	7
Total number of samples by Sugar group				52

Mercury concentrations were below the chronic and acute Class B surface water quality standard at all stations sampled, and concentrations were consistent from the upper to lower reaches of the river.

5.8.2 Recommendations

- Continue sampling at all stations where a potential problem with mercury is suspected; this will help to build a long-term data set to better understand trends as time goes on.

5.9. Lead

5.9.1. Results and Discussion

Between four and eight samples were collected for lead at nine stations in five different towns along the Sugar River (Table 5-9). All sample results are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for lead are as follows:

freshwater chronic criterion <0.00054 mg/l
freshwater acute criterion <0.014 mg/l

Table 5-9. Lead data summary for the Sugar River, New Hampshire, May-December , 2002, DES VRAP.

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	4	<0.001 - 0.0014	0	4
16-Sgr	3	<0.001 - 0.0024	0	3
12-Sgr	5	<0.001 - 0.0023	0	5
10-Sgr	4	<0.001 - 0.0023	0	4
7-Sgr	8	<0.001 - 0.0035	0	8
5-Sgr	7	<0.001-0.0014	0	7
1-Sgr	7	<0.001 - 0.0034	0	7
4-Ssr	6	<0.001 - 0.0018	0	6
2-Nsr	7	<0.001 - <0.002	0	7
Total measurements/samples by Sugar group				51

Lead concentrations were below the chronic and acute Class B surface water quality standard at all stations sampled, and concentrations were consistent from the upper to lower reaches of the river. However, it is important to note that the surface water quality standard for lead is dependent on water hardness; consequently, when sampling for lead, it is important to also take water hardness samples so that the appropriate water quality criterion for lead can be determined.

5.9.2. Recommendations

- Continue sampling at all stations where a potential problem with lead is suspected; this will help to build a long-term data set to better understand trends as time goes on.

5.10. Arsenic

5.10.1.1. Results and Discussion

Between four and eight samples were collected for arsenic at nine stations in five different towns along the Sugar River (Table 5-8). All sample results are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for arsenic are as follows:

freshwater chronic criterion <0.15 mg/l
freshwater acute criterion <0.34 mg/l

Table 5-10. Arsenic data summary for the Sugar River, New Hampshire, May-December , 2002, DES VRAP.

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	4	<0.001 - <0.005	0	4
16-Sgr	3	<0.001	0	3
12-Sgr	5	<0.001	0	5
10-Sgr	4	<0.001	0	4
7-Sgr	8	<0.001 - <0.005	0	8
5-Sgr	7	<0.001 - <0.005	0	7
1-Sgr	7	<0.001-<0.005	0	7
4-Ssr	6	<0.001 - <0.005	0	6
2-Nsr	7	<0.001 - <0.005	0	7
Total measurements/samples by Sugar group				51

Arsenic concentrations were below the chronic and acute Class B surface water quality standard at all stations sampled, and concentrations were consistent from the upper to lower reaches of the river. However, it is important to note that the surface water quality standard for arsenic is dependent on water hardness consequently, when sampling for arsenic, it is important to also take water hardness samples so that the appropriate water quality criterion for arsenic can be determined.

5.10.2. Recommendations

- Continue sampling at all stations where a potential problem with arsenic is suspected; this will help to build a long-term data set to better understand trends as time goes on.

5.11. Alkalinity

5.11.1. Results and Discussion

Between four and eight samples were collected for alkalinity at nine stations in five different towns along the Sugar River (Table 5-8). All sample results are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for arsenic are as follows:

freshwater chronic criterion 20 mg/l
freshwater acute criterion no standard

Table 5-11. Alkalinity data summary for the Sugar River, New Hampshire, May-December , 2002, DES VRAP.

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	6	4.6 - 5.3	Not Applicable	6
16-Sgr	5	4.7. - 6.3	N/A	5
12-Sgr	6	6.2 - 8.8	N/A	6
10-Sgr	5	6.4 - 10.4	N/A	5
7-Sgr	6	5.5 - 11.5	N/A	6
5-Sgr	6	8.3-14.4	N/A	6
1-Sgr	8	7.7 - 23.9	N/A	8
4-Ssr	6	3.9 - 8.4	N/A	6
2-Nsr	6	4.4 - 13.6	N/A	6
Total measurements/samples by Sugar group				54

Alkalinity is a measure of the buffering capacity of water and is an important indicator of the ability of a rivers ability to absorb acidic pollution from surface runoff or precipitation without a significant lowering of pH.

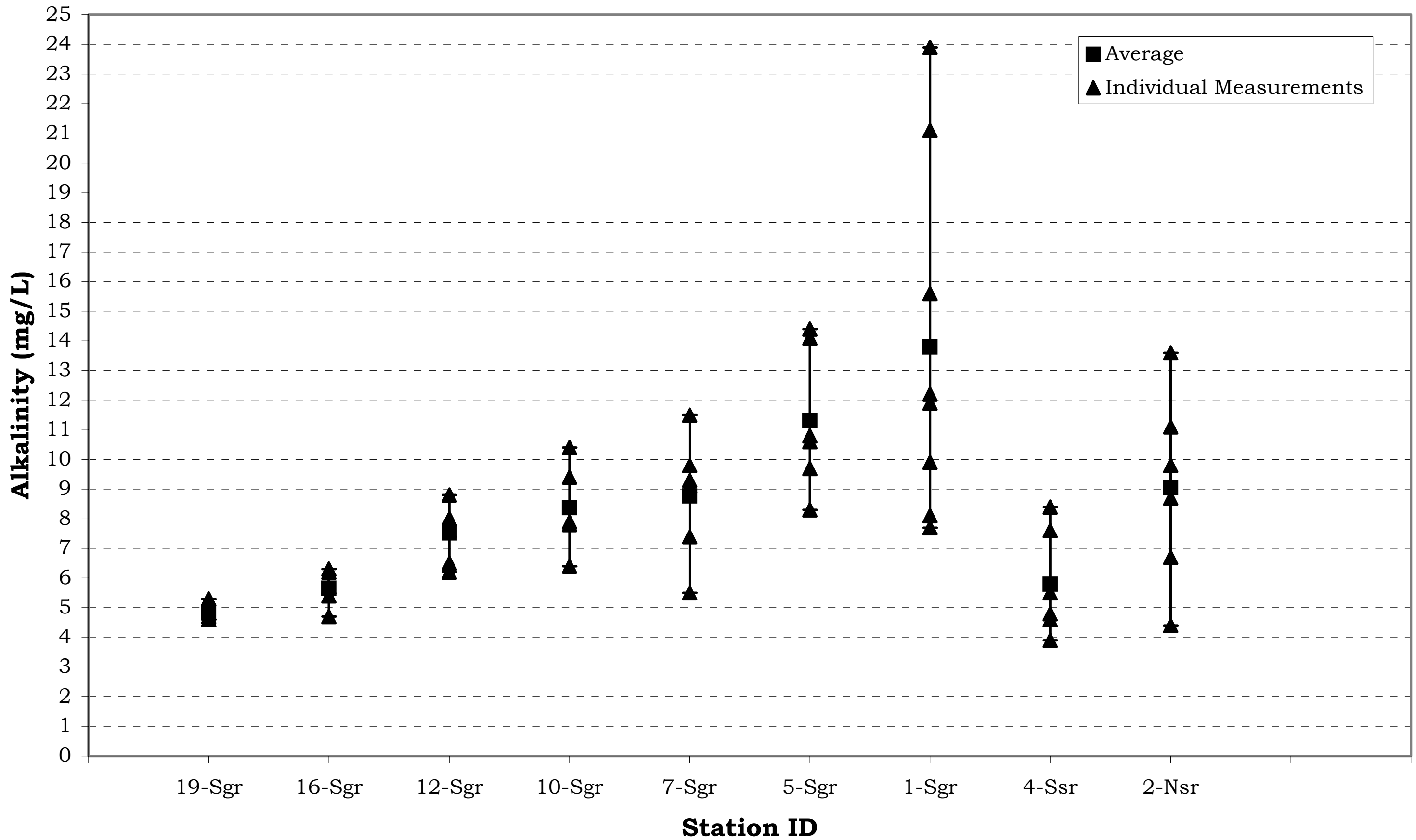
Alkaline compounds in the water such as bicarbonates (baking soda is one type), carbonates, and hydroxides lower the acidity of the water (which means increased pH). Without this acid-neutralizing capacity, any acid added to a stream would cause an immediate change in the pH. Alkalinity in streams is influenced by rocks and soils, salts, certain plant activities, and certain industrial wastewater discharges.

The average alkalinity measurement in 2002 for the Sugar River was 13.4 mg/L[Figure 5-11]. This is higher than the total average alkalinity measurement on the Sugar River from 1985-2002 of 8.4mg/L. The alkalinity measurements in 2002 are well within the range of what would be considered normal for this area of New Hampshire.

5.11.2. Recommendations

- Continue sampling at all stations; this will help to build a long-term data set to better understand trends as time goes on.

Figure 5-11 Alkalinity Statistics for the Sugar River, New Hampshire, March 5 - December 10, 2002, NHDES VRAP



5.12. Biochemical Oxygen Demand

5.12.1. Results and Discussion

Between four and eight samples were collected for biochemical oxygen demand (BOD) at nine stations in five different towns along the Sugar River (Table 5-8). All sample results are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standard for biochemical oxygen demand does not exist.

Table 5-12. Biochemical Oxygen Demand data summary for the Sugar River, New Hampshire, May-December , 2002, DES VRAP.

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2004 NH Surface Water Quality Assessment
19-Sgr	10	6.95 - 9.15	Not Applicable	10
16-Sgr	11	3.05 - 8.7	N/A	11
12-Sgr	11	5.88 - 8.88	N/A	11
10-Sgr	11	5.28 - 8.66	N/A	11
7-Sgr	11	5.62 - 8.82	N/A	11
5-Sgr	12	3.56-8.28	N/A	12
1-Sgr	11	3.5 - 8.57	N/A	11
4-Ssr	9	6.88 - 8.9	N/A	9
2-Nsr	8	4.5 - 9.32	N/A	8
Total measurements/samples by Sugar group				94

Biochemical oxygen demand (BOD) is a measurement of the rate at which available oxygen is consumed by bacteria and other microorganisms during decomposition. BOD is an excellent indicator of the degree of organic pollution loading from sources such as wastewater treatment facilities. Organic matter loading from sources such as plant decay leave liter are natural components of all rivers in New Hampshire.

However the rate of plant growth and decay can be unnaturally accelerated when human activity leads to excessive sunlight from the removal of riparian vegetation or nutrients being carried into the river from runoff.

If an excessive amount of organic pollutant loading occurs in the river it greatly increases decomposition and thus removes oxygen that would otherwise be available for aquatic life. As was discussed in Section 5.1 the Class B standard for dissolved oxygen concentration is 5mg/L in any single sample. Elevated BOD can cause the concentration levels to go well below the standard.

Biochemcial oxygen demand measurements during 2002 on the Sugar River were higher than state averages. The average of all readings on the Sugar River for 2002 was 7.05 mg/L. From 1985 –2002 the average BOD measurement on New Hampshire rivers is 1.52 mg/L. This could indicate potential problems on the Sugar River that could impact dissolved oxygen concentrations. The ongoing TMDL study being done on the Sugar River is focused on dissolved oxygen. The BOD data collected in 2002 will be valuable to the ongoing TMDL.

5.12.2. Recommendations

- Continue sampling at all stations; this will help to build a long-term data set to better understand trends as time goes on.

Figure 5-12 Biochemical Oxygen Demand Statistics for the Sugar River, New Hampshire, March 5, - December 10, 2002, NHDES VRAP